Nov. 10, 1936. L. L. MARKEL 2,060,093

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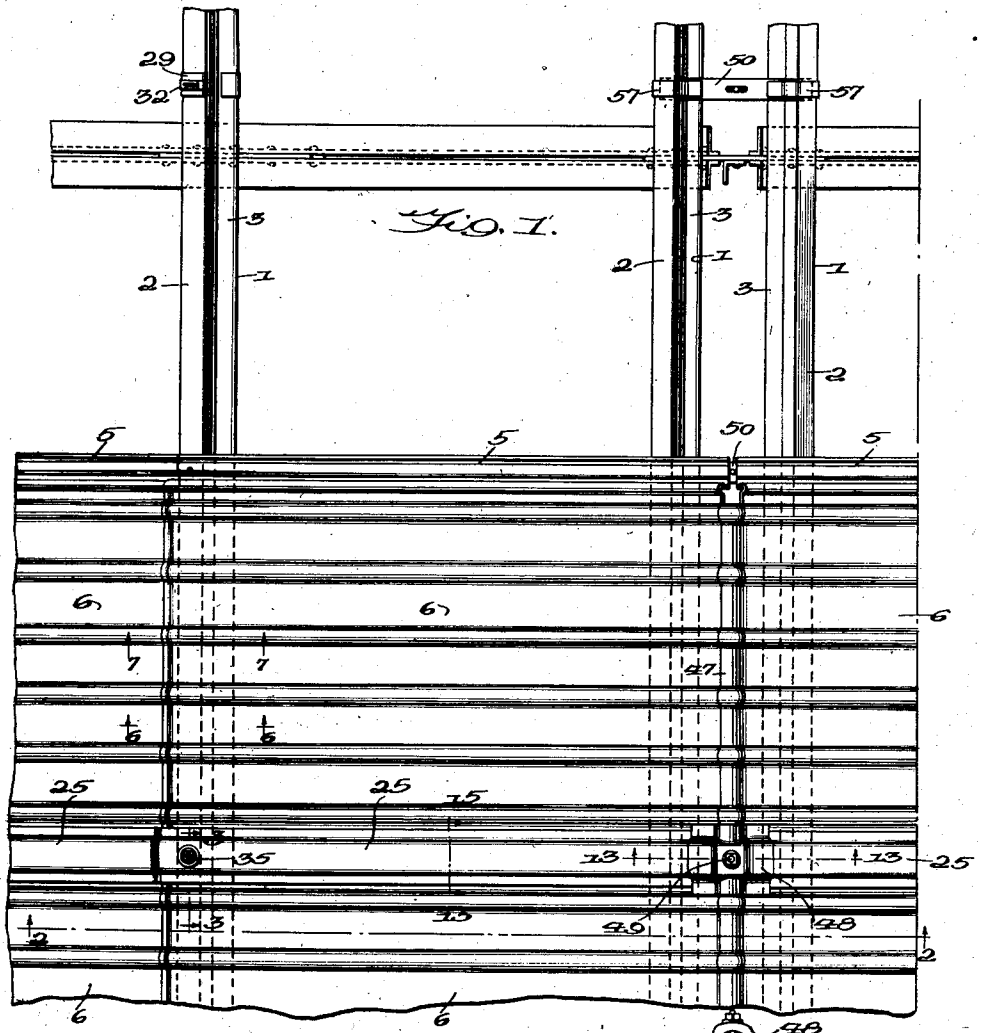


Fig. 1.

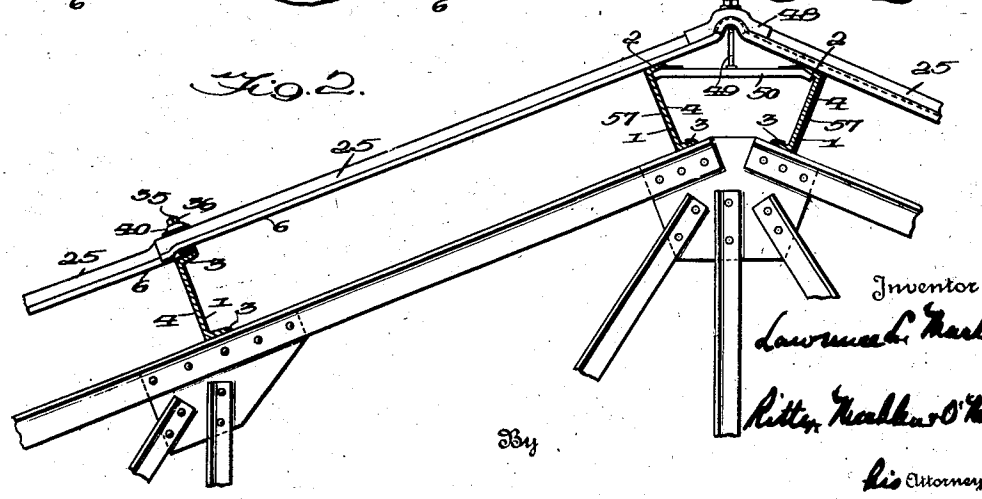


Fig. 2.

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His Attorneys

Nov. 10, 1936. L. L. MARKEL 2,060,093

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Filed July 8, 1935 4 Sheets-Sheet 2

Fig. 3.

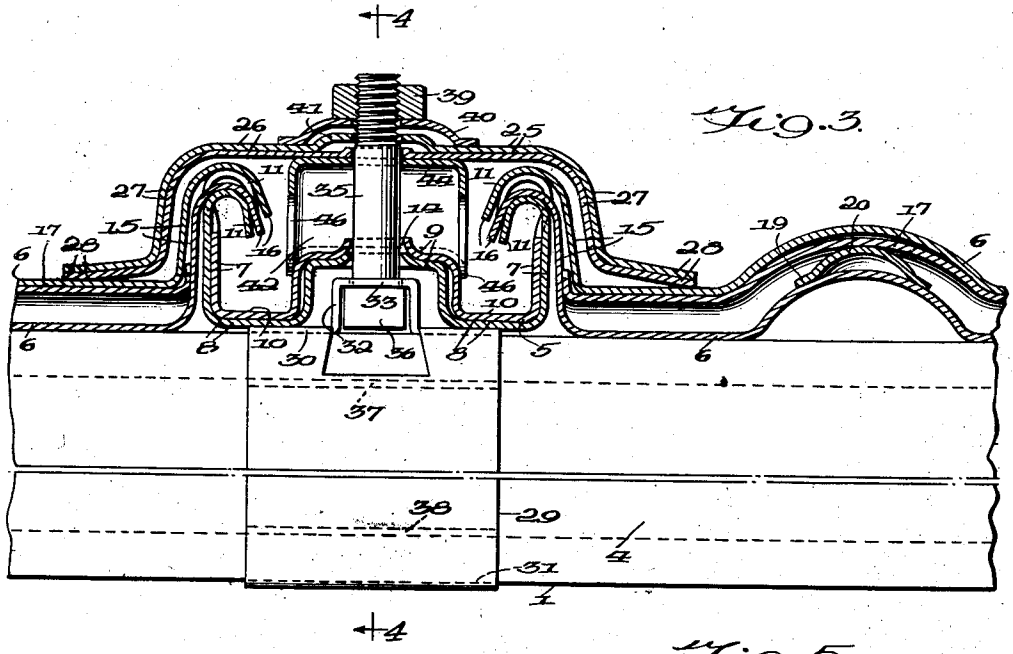


Fig. 4.

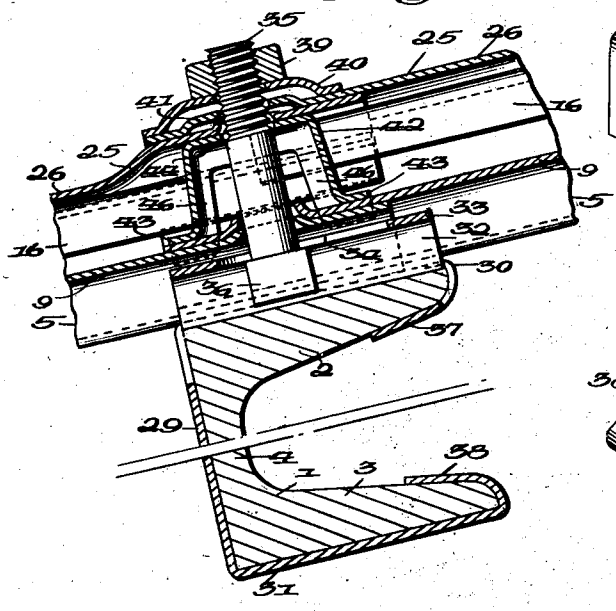
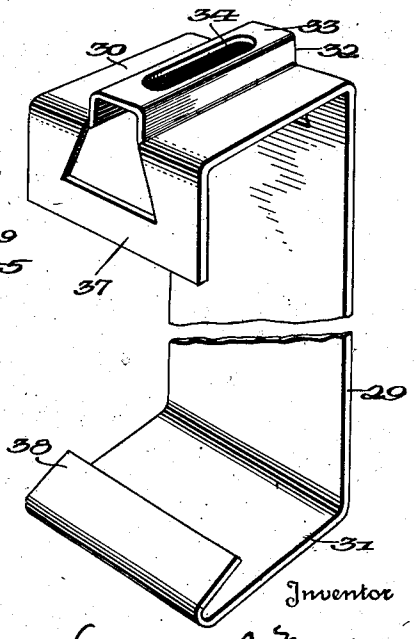


Fig. 5.



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Nov. 10, 1936. L. L. MARKEL 2,060,093

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Filed July 8, 1935 4 Sheets-Sheet 3

Fig. 6.

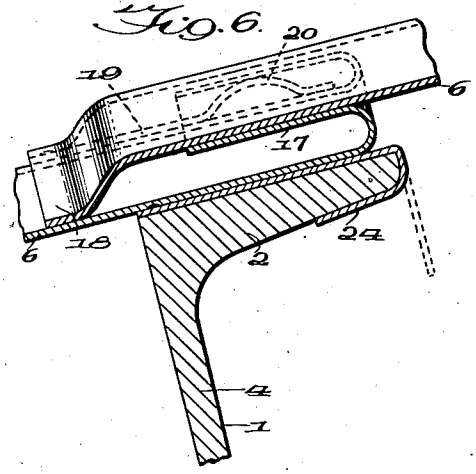


Fig. 7.

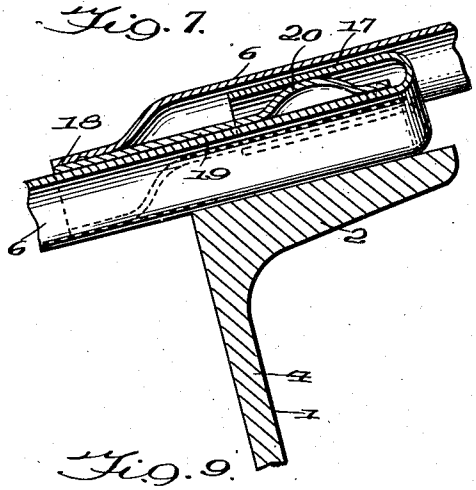
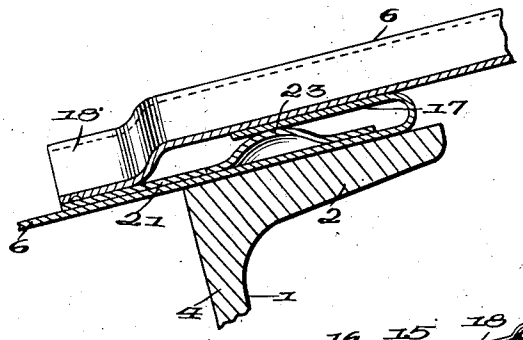


Fig. 9.

Fig. 8.



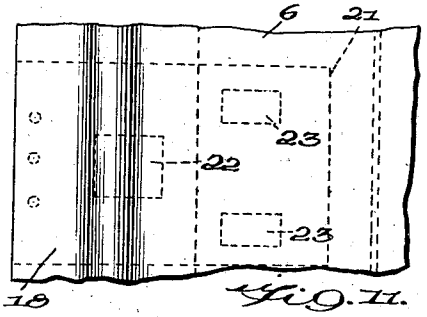
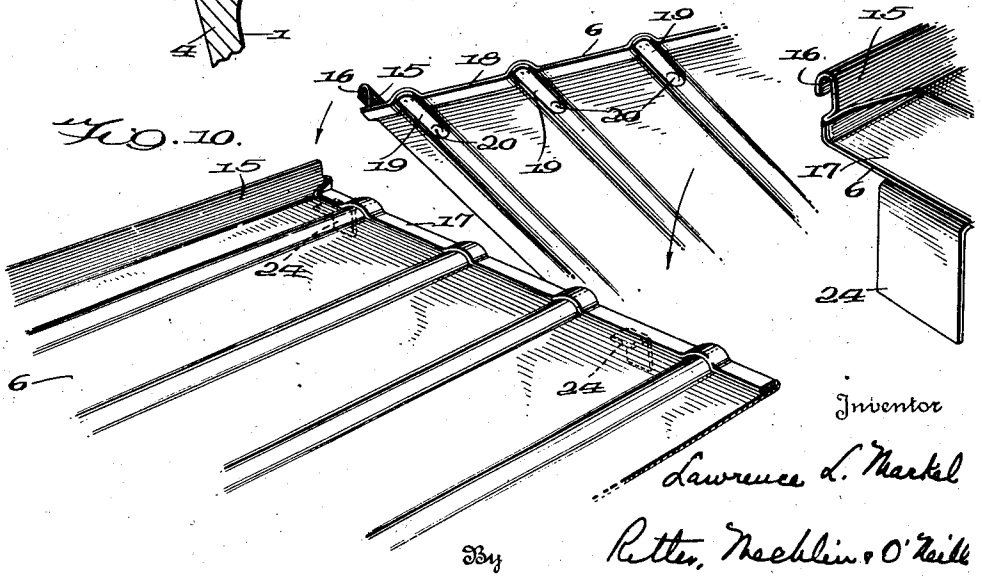


Fig. 11.

Fig. 10.



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Nov. 10, 1936. L. L. MARKEL 2,060,093

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Filed July 8, 1935 4 Sheets-Sheet 4

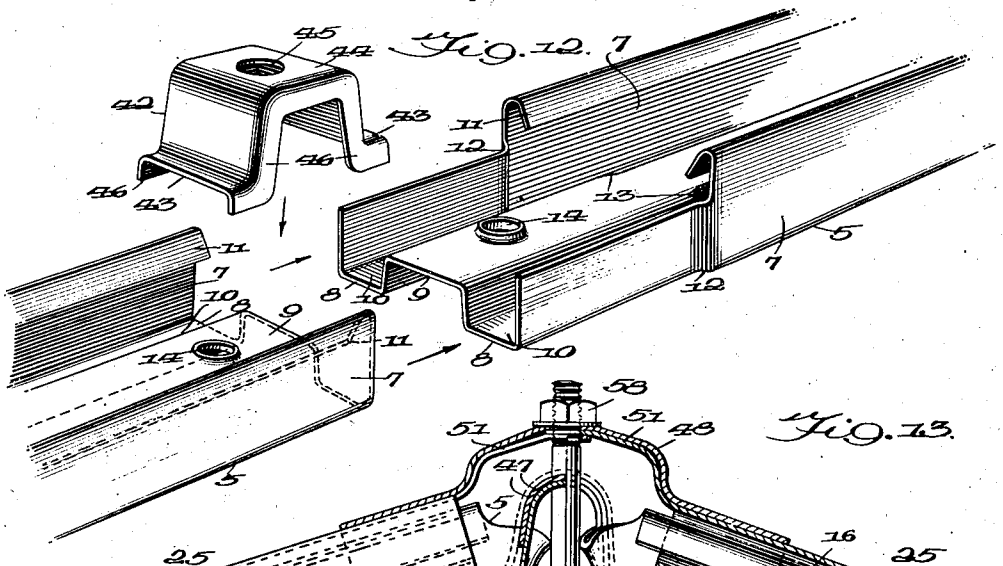


Fig. 12.

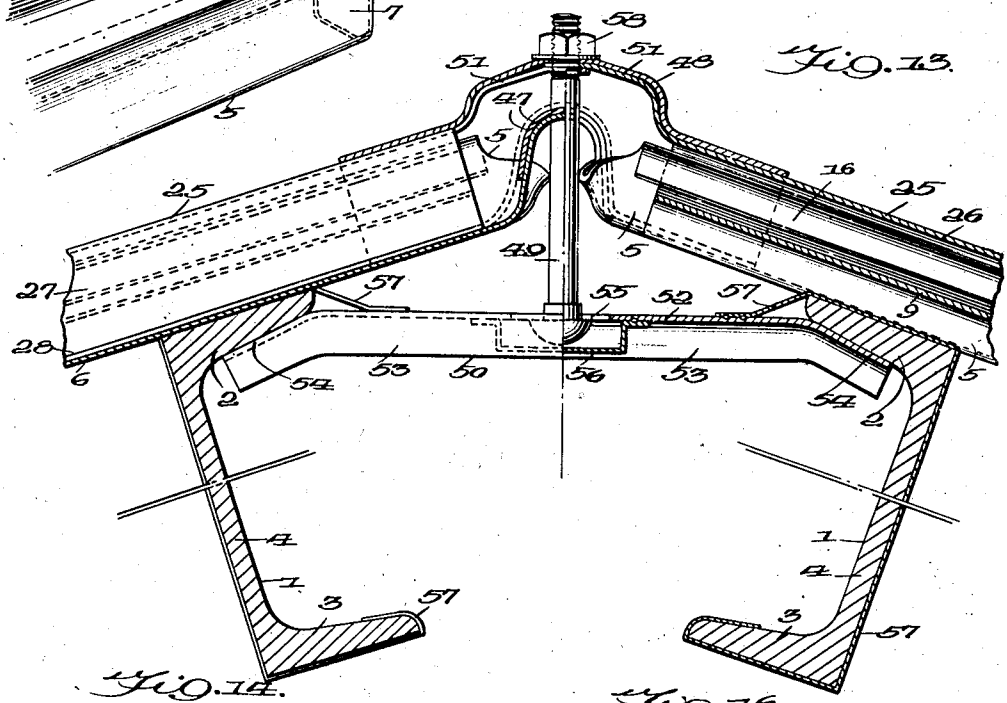
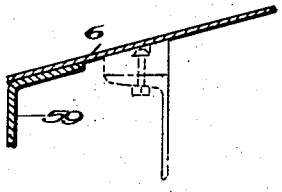
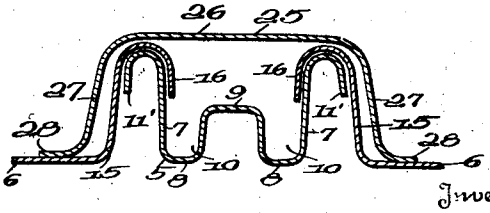


Fig. 13.

Fig. 14.

Fig. 16.





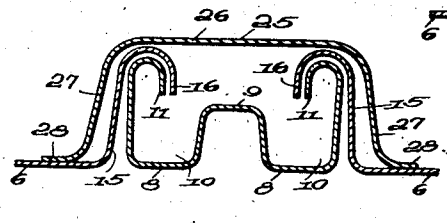


Fig. 15.

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Patented Nov. 10, 1936 2,060,093

UNITED STATES PATENT OFFICE

2,060,093

ROOF

Lawrence L. Markel, Warren, Ohio, assignor to Chicago-Cleveland Car Roofing Co., Chicago, Ill., a corporation of Delaware

Application July 8, 1935, Serial No. 30,361

9 Claims. (Cl. 108—13)

My invention relates to roofs and it has for its principal object to provide a weather-tight metal roof capable of use with or without a roof deck and the component parts of which are so related that they will not be affected, due to temperature changes, by contraction or expansion of the roof or the building to which it is applied.

Another object of the invention is to provide a metal roof which can be easily and quickly applied to a building from the outside thereof without erecting scaffolding within the building.

Another object of the invention is to provide a metal roof of such construction that it may be readily applied to and removed from a building without damage or destruction of its various parts, so that, after being once assembled, it may thereafter be disassembled and reapplied to another building.

Another object of the invention is to provide a metal roof which will not be subjected to strains and stresses resulting from vibrations or other movements of the building to which it is applied.

Other objects and the various features of the invention residing in advantageous forms, combinations and relations of parts will hereinafter appear and be particularly pointed out in the claims.

In the drawings,

Figure 1 is a fragmentary plan view of the roof and some of its frame members adjacent the ridge.

Figure 2 is a vertical sectional view taken on line 2—2 of Figure 1.

Figure 3 is an enlarged sectional view taken on line 3—3 of Figure 1.

Figure 4 is a sectional view taken on line 3—3 of Figure 3.

Figure 5 is a perspective view of one of the brackets employed for connecting the roof to the roof frame.

Figure 6 is an enlarged detail sectional view taken on line 6—6 of Figure 1.

Figure 7 is an enlarged detail sectional view taken on line 7—7 of Figure 1.

Figure 8 is a view similar to Figure 6 illustrating a modified form of the invention.

Figure 9 is a plan view of the lower edge portion of the uppermost roof sheet illustrated in Figure 8.

Figure 10 is a composite view illustrating in perspective a top view of the upper or ridge edge of one roof sheet and an under side view of the lower or eaves edge of an adjacent roof sheet.

Figure 11 is an enlarged detail perspective view of the upper or ridge edge of one of the sheets adjacent a corner thereof.

Figure 12 is a disassembled view showing two of the trough members of the roof and one of the cap supports.

Figure 13 is an enlarged vertical sectional view taken on line 13—13 of Figure 1.

Figure 14 is a detail sectional view of the roof adjacent an eaves edge thereof.

Figure 15 is an enlarged sectional view taken on line 15—15 of Figure 1.

Figure 16 is a view similar to Figure 15 illustrating a modified form of the invention.

Referring more particularly to the drawings, a typical roof truss is shown in Figure 2 on which is mounted a plurality of purlins 1 of substantially channel-shape, each including upper and lower flanges 2 and 3, respectively, and a connecting web 4. It will be obvious as the specification proceeds that the roof is not limited in its application to purlins of the form chosen for purposes of illustration and that, by simple modifications which will become evident, the roof may be applied to a roof deck without affecting the principal parts of the roof.

The roof includes trough members 5 which extend from the ridge to the eaves of the roof and, together with the purlins 1, afford supports for the roof sheets 6. Each of the trough members is preferably a pressed metal section and is formed with substantially vertical side walls 7 which are connected at their lower edges by a web 8. The central portion of the web of each of the troughs is raised, as indicated at 9, to form two separate water carrying grooves or channels 10 and the upper edges of the side walls 7 are curved and respectively terminate in down-turned flanges which, as indicated in the principal figures of the drawings at 11, may be disposed inwardly of the side walls or, as indicated in Figure 16 at 11', may be disposed outwardly of the side walls. By forming the webs of the trough members with the raised central portions 9, a section of adequate stiffness and rigidity is obtained for supporting the side edges of the sheets and the down-turned flanges 11 serve to additionally strengthen the trough members.

Although the trough members which are laterally spaced from each other may each be formed as a single member extending continuously from the ridge to the eaves of the roof, it is preferred to form each trough in a plurality of sections, especially in cases of large roofs, so that the sections may be easily handled and thus applied with greater facility. When formed in sections,

the eaves end of each section, that is the end nearest the eaves, is formed (see Figure 12) so as to extend within the ridge end, that is the end nearest the ridge, of the adjoining section. To enable the eaves ends of the trough sections to fit within the ridge ends of the sections, the side walls of the former are offset inwardly, as indicated at 12, the sides of the central raised portions thereof are offset outwardly, as indicated at 13, and the side walls 7 are also reduced in height and the down-turned flanges omitted from adjacent the offsets 12. The adjoining ends of the trough sections are formed with aligned apertures 14 in the raised central portions thereof to receive means to be hereinafter described for not only connecting the sections together but also for connecting them and other parts of the roof to the roof frame.

A plurality of the roof sheets 6 are interposed between the trough members in end to end relation with their adjoining edges disposed in overlapping relation. The roof sheets are preferably of such size that, where they overlap each other, they will be supported by the purlins or supporting members 1. Along their side edges, the sheets are formed with upwardly extending portions 15 terminating in reverse bends or flanges 16 adapted to hook over and be supported by the curved upper edges of the side walls 7 of the trough members. The return flanges 16 are spaced a greater distance from the upwardly extending portions 15 of the roof sheets than the down-turned flanges 11 or 11' of the trough are spaced from the side walls 7 of the trough, so that the sheets may move sidewise with respect to the troughs and thus be unaffected by expansion or contraction of the roof or building frame or to any movements of the frame. The ridge edge of each roof sheet, with the exception of the sheet nearest the ridge of the roof, is provided with an upwardly spaced return flange 17 and the eaves edge of each roof sheet, with the exception of the sheet nearest the eaves of the roof, overlaps the return flange of the adjacent roof sheet and terminates in a downwardly offset portion 18 engaging the main body portion of that sheet. Secured to the under side of the offset portions 18 of each of the sheets and extending toward the ridge edge thereof are a plurality of finger-like members 19 which extend beneath the return flange 17 of the adjacent sheet. The finger-like members 19 are preferably disposed within corrugations, with which the sheets may be advantageously formed to provide a surplus of stiffness, and they may be conveniently secured to the sheets in any suitable manner, such as by spot welding.

The forward ends of each of the finger members is preferably formed so as to have wedging engagement with the under sides of the return flanges 17 to thereby insure a tight lapping of the sheets. This wedging cooperation between the fingers and return flanges 17 may be easily effected by merely forming the fingers with upwardly offset portions, as indicated at 20. These portions are preferably disposed slightly inwardly of the extreme forward ends of the fingers so that the fingers may be readily inserted beneath the return flanges.

By forming the cooperating eaves and ridge edges of the sheets in the manner described, it will be perceived that the sheets are firmly interlocked and that water is effectively prevented from passing between them into the building by the return flanges 17. However, as the finger-like members 19 are narrow and are spaced from each other, condensation collecting on the under sides of the roof sheets will not be entrapped upon flowing down to the eaves edges of the sheets, but will seep out between the sheets to the exterior of the roof.

Instead of disposing the finger members within the corrugations of the sheets, they may be secured to the under side of the sheets between the corrugations and be formed in the manner illustrated in Figures 8 and 9. In the form of the invention illustrated in these figures, the finger members 21 are formed adjacent their inner edges with centrally disposed drain openings 22 and they are also formed adjacent their forward edges with offset wedging portions 23 similar to the offset portions 20 of the fingers 19. The drain openings 22 enable condensation collecting above the fingers to pass to the upper side of the ridge edge of the adjoining sheet so as to seep out between the sheets.

A series of ductile tabs or clips 24 are secured, preferably by spot welding, to the under side of the sheets along their ridge edges, whereby, upon simply bending the tabs around the under side of the upper flange 2 of the cooperating purlin, as indicated in Figure 6, the upper ends of the sheets may be easily and firmly attached to the roof frame. Upward lift of the ridge edges of the sheets by wind pressure within or without the building is thus effectively prevented by the ductile tabs and upward lift of the eaves edges of the sheets is similarly prevented by the finger-like members 19 or 21 and the cooperating return flanges 17 on the ridge ends of the sheets.

Enclosing each of the trough members 5 and the cooperating side edges of the sheets is a cap member 25 which, like the trough member, may, if desired, be formed in a plurality of sections. Each of the cap members is of substantially channel-shape having a web 26 and downwardly extending sides 27 which respectively terminate in laterally projecting flanges 28 adapted to overlappingly engage portions of the roof sheets adjacent the upwardly extending portions 15 thereof. When the cap members are formed in sections, they are adapted to interfit with one another in substantially the same manner as the trough sections, as illustrated in Figure 4, and the webs of the interfitting portions of the cap sections are provided with registrable apertures for receiving the same fastening means the apertures of the trough sections are adapted to receive. These fastening means each include a ductile bracket 29 which is formed so as to embrace the cooperating purlin 1. Each bracket 29 may be conveniently formed from a single sheet of metal and, before being applied to the purlin, it is bent so as to provide upper and lower walls 30 and 31, respectively, adapted to overlappingly engage the outer sides of the upper and lower flanges 2 and 3 of the purlin. The top wall of each bracket is provided with an upwardly offset substantially channel-shape portion 32, the web 33 of which is slotted, as at 34, to receive a bolt 35 having a head 36 of greater width than the slot. Before the bracket is applied to the purlin, the bolt is inserted within the slot with its head 36 disposed within the channel 32 and, after the bracket has been positioned on the purlin by being slid transversely thereof, the outer ends 37 and 38 of the top and bottom walls, respectively, of the bracket are bent around the flanges of the purlin into the position shown in Figure 4. When the bracket is thus assembled, the head 36 of the bolt will

rest upon the top flange of the purlin and the channel portion **32** of the bracket in which the bolt head is located is so proportioned that the bolt will be maintained in an upright position. In Figure 5, the bracket **29** is shown separate from the purlin and the outer end of the bottom wall **38** is shown in the position it occupies after the bracket has been assembled with the purlin, while the outer end **37** of the top wall of the bracket is shown as having been partially bent into a substantially vertical position.

Each of the securing bolts **35** extend upwardly through the registering apertures in the adjacent trough and cap sections and its upper end is threaded to receive a nut **39**. Interposed between each of the nuts **39** and the outer side of the adjacent cap section is an upwardly embossed washer **40** and, to prevent water which might seep between the washer and cap section from leaking into the building through the bolt receiving apertures of the cap and trough sections, the eaves end of each cap section is embossed upwardly, as at **41**, around the aperture. The other end of the cap section and the ridge and eaves ends of the trough section may be flanged upwardly around the bolt receiving apertures thereof to serve as an additional safeguard for excluding water. Interposed between the caps and troughs are supports **42**, each of which may advantageously be of substantially channel-shape having lateral flanges **43** adapted to rest upon the raised central portion **9** of the associated trough member and a web **44** having an aperture **45** for receiving bolt **35**. The supports, which serve as spacers preventing collapse of the webs **26** of the cap members, may be rigidified by being formed with substantially vertical side flanges **46** which are spaced laterally a sufficient distance to extend downwardly on opposite sides of the raised central portions of the trough members.

The laterally projecting flanges of the cap **28** are preferably inclined downwardly and are so proportioned and formed that they will engage adjacent portions of the roof sheets prior to engagement of the web **26** of the cap with the cooperating support **42**. When the nut **39** on bolt **35** is tightened, the outer edges of the flanges **28** will, therefore, tightly engage the roof sheets. However, if, for some reason, such as accidental distortion or bending of the caps before they are applied to the roof, the flanges of the caps do not make close contact with the roof sheets, the weather tightness of the roof will not be materially affected, since water blown between the caps and the roof sheets and over the upwardly extending portions **15** of the latter will drop into the longitudinal grooves **10** of the trough portions defined by the raised central portions thereof and be conducted to the eaves of the roof.

The edges of the sheets adjoining the ridge of the roof are formed with lapping corrugations **47** to form a rigid seam along the roof's ridge. The spaces between the side edges of the roof at the ridge thereof are closed by ridge caps **48** which are formed to fit the contour of the caps **25** and the ridge corrugations **47** of the roof sheets. Each of the ridge caps is preferably anchored to the roof frame by a bolt **49** which is carried by a transversely extending bracket **50**. The cap members **25** may, if desired, be conveniently connected to the bolts **49** by providing their web portions with extensions **51**, the outer ends of which lap each other and are formed with apertures for receiving the bolts.

The transversely extending bracket **50** of each of the ridge cap securing devices may be of channel-shape having a web **52** and legs **53** and its outer ends are inclined downwardly, as indicated at **54**, to under-lappingly engage the top flanges **2** of the oppositely facing purlins **1** which are disposed adjacent to and on opposite sides of the ridge of the roof. The web **52** of each bracket is formed at its central portion with an elongated slot **55** for receiving the headed bolt **49** which is maintained in assembled relation with the bracket by a U-shaped keeper or the like **56** which may be conveniently secured to the under side of the web by spot welding. Fastened to the bracket, as by spot welding, inwardly of its downwardly inclined ends **54** are ductile straps or the like **57** which are adapted to be bent around the adjacent purlins **1** to hold the bracket in place prior to the erection of other roof parts. After the ridge caps have been assembled in their proper relation to other parts of the roof and the nuts **58** with which the bolts **49** are provided at their outer ends are tightened, the ductile straps become functionless and portions of the roof intervening between the ridge caps and brackets **50** are firmly clamped onto the purlins.

It will, of course, be appreciated that the eaves of the roof may be secured to the roof framing in any suitable manner and the framing at the eaves has, therefore, been only diagrammatically illustrated in Figure 14. However, I have discovered that it is particularly desirable to reenforce the extreme eaves edges of the roof and this may be conveniently accomplished by securing to the under side of the sheets at the eaves an angularly-shaped reenforcing member **59**.

From the foregoing, it will be readily appreciated that the various parts of the roof are of simple and sturdy construction and that they may be easily and quickly applied to a building from the exterior thereof without the necessity of erecting expensive scaffolding within the building. It will also be appreciated that the roof sheets are so formed and connected with each other and to adjoining parts of the roof that they are free to expand and contract and that they will, therefore, not be subjected to injurious stresses or strains resulting from vibratory or other movements of the roof framing. Moreover, the various parts of the roof are of such design and construction that they need not be made with extreme precision and that ample provision is made to compensate for inaccuracies of manufacture without detracting from the weather tightness of the roof.

What I claim is:

1. A roof including longitudinal supports, trough members carried by the supports, each of said trough members being provided with side walls and a web connecting the lower ends of the side walls having a raised central portion defining two longitudinally extending grooves, a plurality of roof sheets interposed between the trough members and arranged in end to end relation with their adjoining edges in interlocking engagement, the interlocking edges of the sheets being supported by said supports and the side edges of the sheets being hooked over the side walls of the trough members and supported thereby, cap members enclosing said trough members and the cooperating edges of the roof sheets, and means for securing the cap and trough members to said supports.

2. A roof including longitudinal supports, trough members carried by the supports, a plural-

ity of inclined roof sheets arranged in end to end relation between the trough members, the upper edge of one of said sheets being provided with an upwardly spaced return flange and the lower edge of the sheet overlapping said upper edge of the first named sheet being provided on its under side with a finger-like member projecting beneath said return flange, the side edges of said sheets being supported by the trough members, cap members enclosing said trough members and the cooperating edges of the roof sheets, and means for securing the cap and trough members to the longitudinal supports.

3. A roof including longitudinal supports, trough members carried by the supports, a plurality of roof sheets interposed between the trough members and arranged in end to end relation with their adjoining edges in overlapping relation, the side edges of said sheets being supported by said trough members, cap members enclosing said trough members and the cooperating edges of the roof sheets, and means for securing the cap and trough members to said supports, said means including a ductile bracket bent to embrace one of the supports and having an upwardly offset inverted channel portion the web of which is provided with an elongated slot, and a bolt movably disposed within the slot and extending upwardly therefrom through said trough and cap members.

4. A roof including two longitudinal frame members disposed adjacent to and on opposite sides of the ridge of the roof, a plurality of transverse members extending downwardly from each side of the ridge, a plurality of roof sheets interposed between said transverse members and arranged in end to end relation with their adjoining edges overlapping each other, cap members enclosing said transverse members and the adjacent edges of the roof sheets, a ridge cap overlapping portions of said cap members and adjoining portions of the sheets adjacent the ridge, means connecting said ridge cap to said frame members, said means including a bracket extending transversely of the ridge and under-lapping portions of the frame members, ductile means secured to the bracket adapted to be bent around said frame members for temporarily supporting said bracket, and bolt means carried by the bracket and extending upwardly therefrom through the ridge cap.

5. A roof including a plurality of roof sheets arranged in end to end relation between the ridge and eaves of the roof with the eaves edge of one roof sheet overlapping the ridge edge of the adjacent roof sheet, said overlapping ridge and eaves edges of the sheets being provided with interlocking means preventing water from passing between the sheets into the building and permitting condensation collecting on the under side of the sheet nearest the ridge to pass between the sheets to the exterior of the building, said interlocking means including an upwardly spaced return flange on said ridge edge and at least one finger-like member on the under side of said eaves edge adapted to extend beneath said return flange.

6. A roof involving a plurality of inclined sheets arranged in end to end relation with their adjoining edges overlapping each other, the upper edge of one of said sheets being provided with an upwardly spaced return flange and the lower edge of another of the sheets being provided with a downwardly offset portion engageable with the first named sheet in advance of said flange and being also provided on its under side with a finger-like member projecting beneath said flange, said finger-like member having a portion engageable with the under side of said flange.

7. A roof including a plurality of inclined roof sheets arranged in end to end relation with their adjoining edges overlapping each other, each of said sheets having a plurality of corrugations extending transversely of the roof, the upper edge of one of said sheets being provided with an upwardly spaced return flange and the lower edge of another of the sheets being provided on its under side with a finger-like member disposed in one of the corrugations thereof and projecting beneath said return flange.

8. A roof involving a plurality of inclined sheets arranged in end to end relation with their adjoining edges overlapping each other, the upper edge of one of said sheets being provided with an upwardly spaced return flange and being also provided with downwardly extending ductile tabs adapted to secure the sheet to a frame member of the roof and the lower edge of another of said sheets being provided on its under side with a finger-like member projecting beneath said return flange.

9. A roof involving a plurality of inclined sheets arranged in end to end relation with their adjoining edges overlapping each other, the upper edge of one of said sheets being provided with an upwardly spaced return flange and the lower edge of another of the sheets being provided on its under side with a finger-like member having wedging engagement with the under side of said return flange, and means connected to one of said sheets adapted to secure the sheets to a frame member of the roof.

LAWRENCE L. MARKEL.